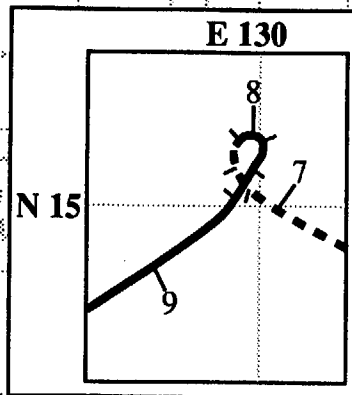


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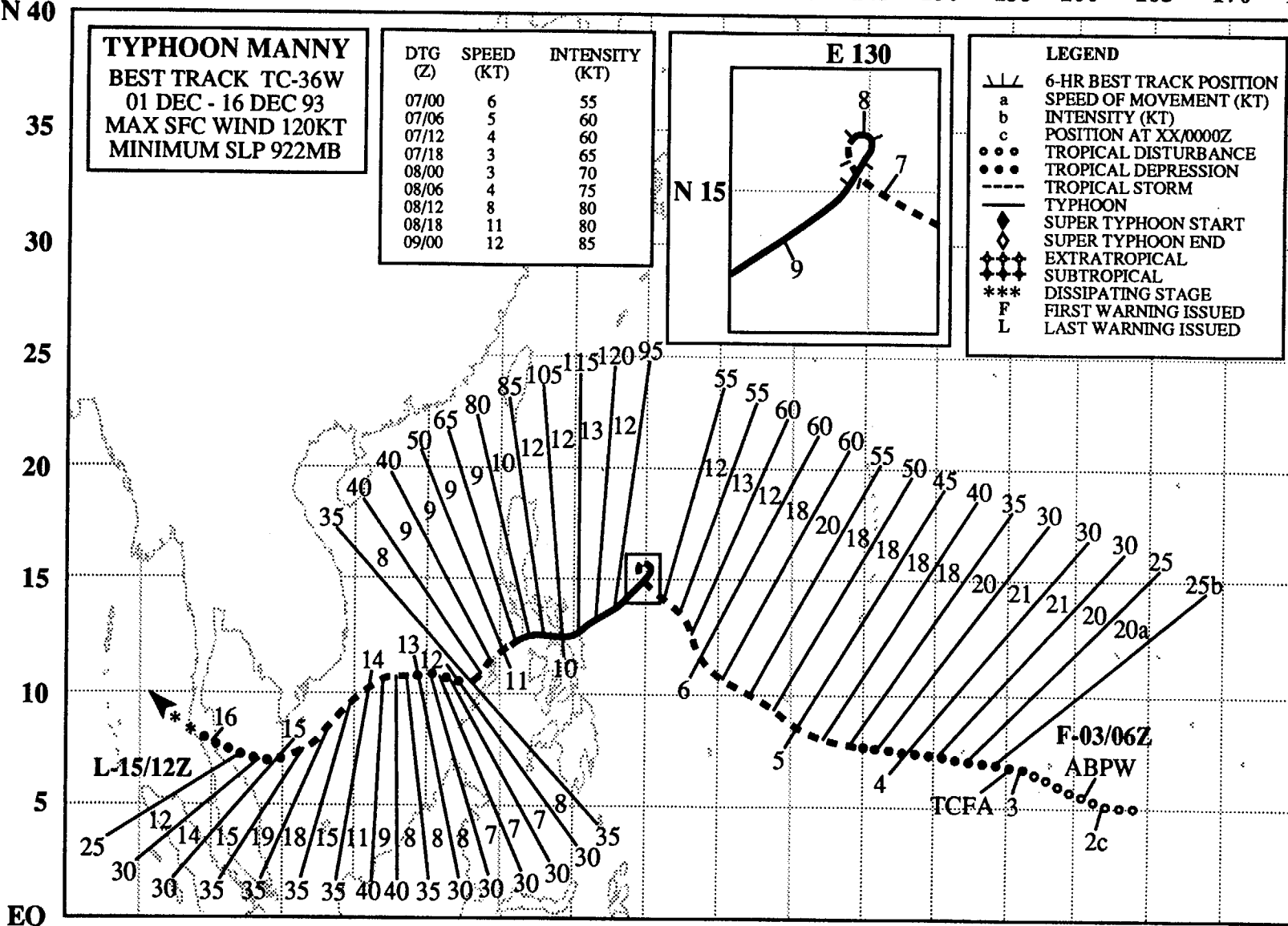
TYPHOON MANNY
BEST TRACK TC-36W
01 DEC - 16 DEC 93
MAX SFC WIND 120KT
MINIMUM SLP 922MB

DTG (Z)	SPEED (KT)	INTENSITY (KT)
07/00	6	55
07/06	5	60
07/12	4	60
07/18	3	65
08/00	3	70
08/06	4	75
08/12	8	80
08/18	11	80
09/00	12	85



LEGEND

- 6-HR BEST TRACK POSITION
- a SPEED OF MOVEMENT (KT)
- b INTENSITY (KT)
- c POSITION AT XX/0000Z
- TROPICAL DISTURBANCE
- TROPICAL DEPRESSION
- - - TROPICAL STORM
- TYPHOON
- ◆ SUPER TYPHOON START
- ◇ SUPER TYPHOON END
- ◆◆◆ EXTRATROPICAL
- ◆◆◆ SUBTROPICAL
- *** DISSIPATING STAGE
- F FIRST WARNING ISSUED
- L LAST WARNING ISSUED



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EQ

TYPHOON MANNY (36W)

I. HIGHLIGHTS

The second of three typhoons to form in a very active near equatorial trough in December, Manny developed in the eastern Caroline Islands. After moving rapidly westward into the Philippine Sea, the tropical cyclone slowed and executed a cyclonic loop before tracking southwestward towards the Philippine Islands. Rapid intensification occurred as Manny approached the Philippine Islands. Once in the South China Sea, Manny, influenced by shear from the Asian northeast monsoon, weakened and meandered west-southwestward until it dissipated over the Malay Peninsula. Typhoon Manny was the 19th significant tropical cyclone of 1993 to directly affect the Philippines, and followed a track almost identical to that of Typhoon Pamela in 1982.

II. CHRONOLOGY OF EVENTS

December

020600Z - Typhoon Manny was first mentioned in the Significant Tropical Weather Advisory as an area of persistent convection within the near equatorial trough east of Pohnpei in the Caroline Islands.

030300Z - Increased convective organization and regional 24-hour pressure falls of 2 to 2.5 mb led to the issuance of a Tropical Cyclone Formation Alert.

030600Z - The first warning on Manny resulted from the combination of improved convective curvature, a satellite intensity estimate of 25 kt (13 m/sec), and surface synoptic data from the Caroline Islands which indicated that a closed low-level circulation was present.

041800Z - Manny was upgraded to tropical storm intensity based on a satellite intensity estimate of 45 kt (23 m/sec). Post analysis indicates that Manny most likely attained tropical storm intensity almost six hours earlier.

080000Z - The appearance of an eye and a satellite intensity estimate of 65 kt (33 m/sec) to an upgrade to typhoon intensity.

151200Z - Final warning was issued on Manny as it was dissipating over the Malay Peninsula.

III. IMPACT

On Yap (WMO 91413), Manny produced sustained winds of 38 kt (20 m/sec) with gusts to 47 kt (24 m/sec), resulting in some minor damage to banana trees, but not to structures. The tropical storm dropped 6.45 inches (165 mm) of rain on the Island. During the early morning hours of 10 December in the Philippine Islands, the typhoon swept across Samar killing at least eight people. This was only 75 nm (139 km) south of where Typhoon Lola (35W) had passed a week earlier, killing at least 230 people and forcing 583,000 to flee their homes.

IV. DISCUSSION

There are two interesting aspects of Manny: its track in the Philippine Sea was virtually identical to that of another typhoon, Pamela (December 1982); and, its rapid intensification while on a southwesterly track.

a. Clockwise loop in the Philippine Sea — On 7 December, Manny (Figure 3-36-1) entered a clockwise loop that took two days to complete. While Manny's motion was unusual, it was not unprecedented, and, in fact, has a near-perfect analog. Figure 3-36-2 compares the track of Manny with that of Typhoon Pamela (1982). Both typhoons performed a clockwise loop approximately 100 nm (185 km)

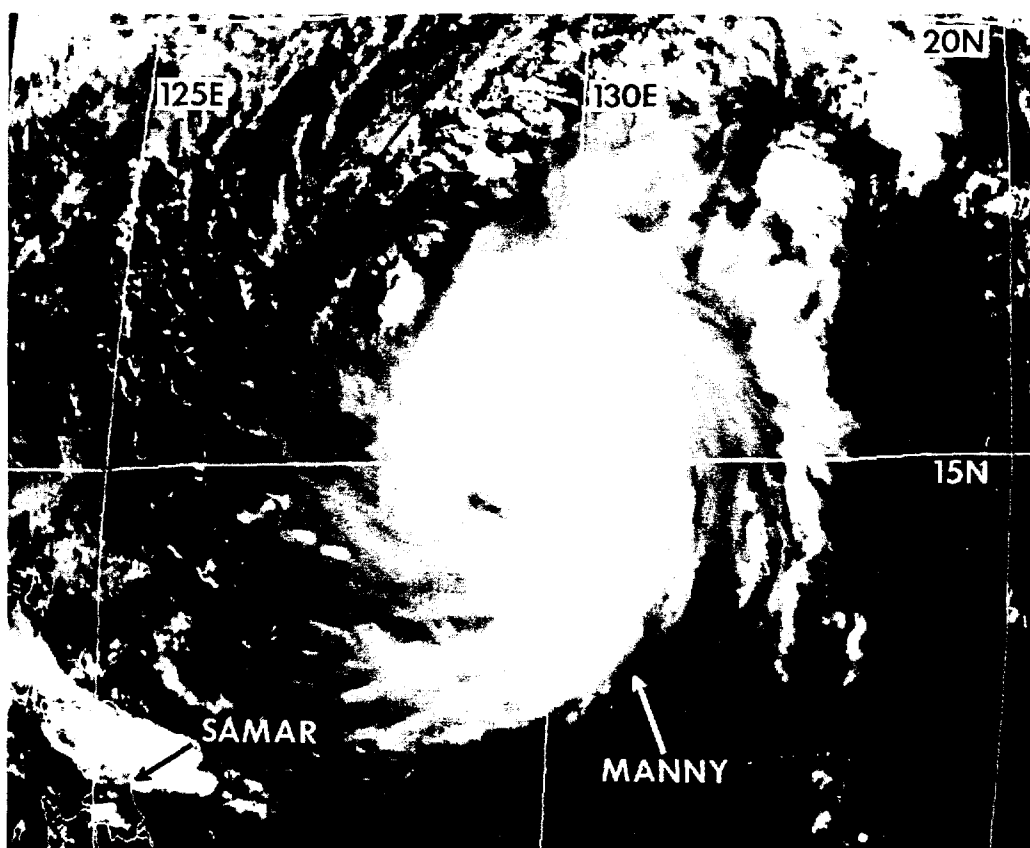


Figure 3-36-1 Approaching typhoon intensity, Manny begins to execute a clockwise loop in the Philippine Sea (070530Z December visual GMS imagery).

in diameter, tracked to the southwest and intensified.

b. Southwestward Track and Intensification — In tropical latitudes, tropical cyclones normally move in a direction north of west. Southwestward tracks while not common, do occur with regularity. There are at least six distinct synoptic patterns that can cause a tropical cyclone to take a prolonged (24 hours or more) southwestward track. Four of these basic synoptic patterns are illustrated in Figure 3-36-3. The first synoptic pattern is the monsoon gyre (Figure 3-36-3a) described by Lander (1994). The second pattern, a surge in the northeast monsoon (Fig. 3-36-3b), occurs in the extreme western North Pacific and South China Sea from October through March. In this case, intensification is either short-lived or does not occur. The third pattern, induced ridging in low latitudes (Fig. 3-36-3c), may be associated with the reverse-oriented monsoon trough. The fourth pattern, dynamic ridging (Fig. 3-36-3d), is characterized by the subtropical ridge expanding. This expansion forces a tropical cyclone to the southwest if the expansion is toward the southeast. Prior to the expansion a storm may respond to synoptic patterns that cause “stepping” and “looping” as identified by Sandgathe (1987). Although similar to the northeast monsoon pattern, tropical cyclones in the dynamic ridge pattern are less likely to weaken, and may even intensify significantly. The fifth and sixth synoptic patterns (not illustrated) are: southwestward motion associated with binary interaction, and tropical cyclones (usually TUTT-induced) that develop in the trade winds between the axes of the monsoon trough and the subtropical ridge. Of the six synoptic patterns, the dynamic ridge pattern (Figure 3-36-3d) applies to the movement of Manny while it was in the Philippine Sea.

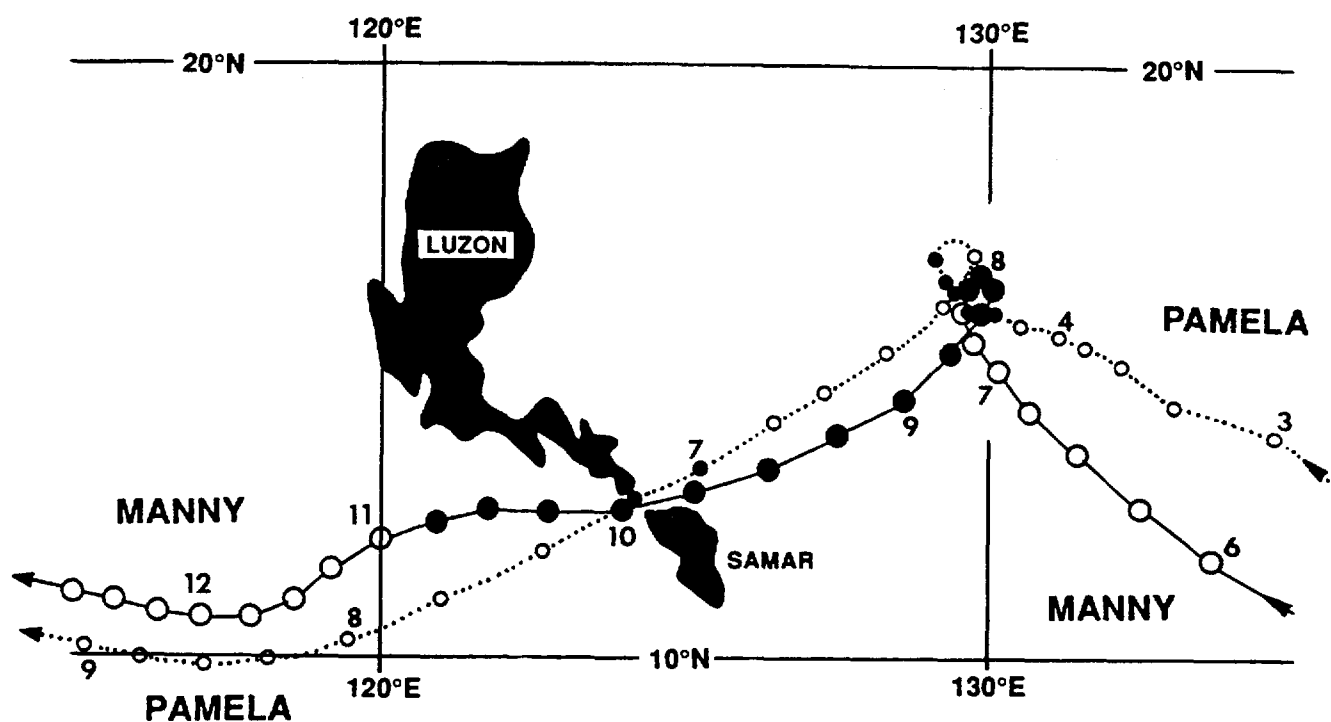


Figure 3-36-2 A comparison of the December tracks of Typhoons Manny (1993) and Pamela (1982) . Both typhoons executed a clockwise loop in virtually the same location, and both intensified on their subsequent southwestward tracks. Manny's track is depicted by large circles connected by solid lines and Pamela's track is depicted by small circles connected with dotted lines. Tropical storm intensities are designated with open circles and typhoon intensities with filled circles. Dates at 0000Z are indicated by small numbers.

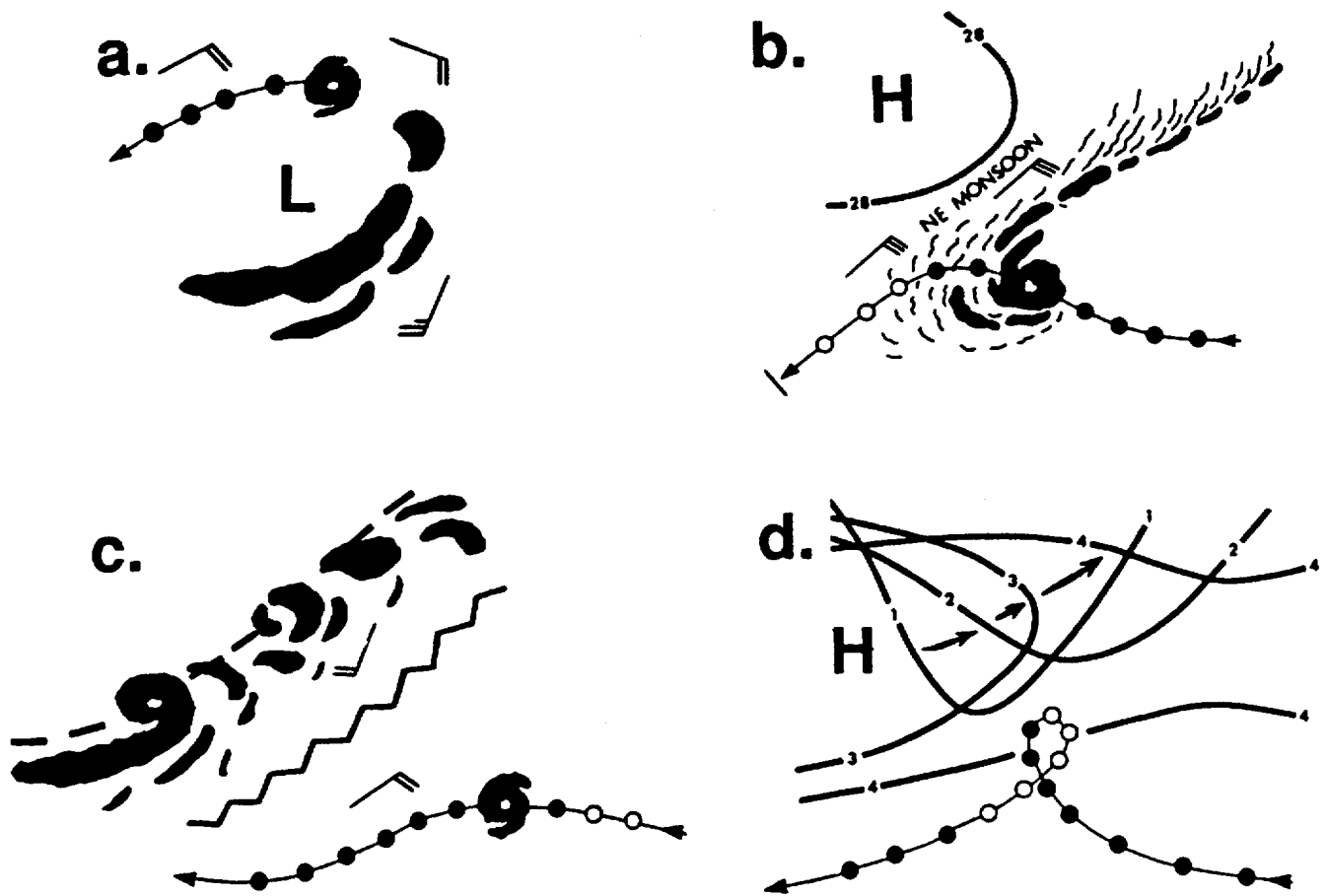


Figure 3-36-3 Primary synoptic patterns that cause tropical cyclones to move on a prolonged southwestward track: (a) Monsoon gyre, (b) northeast monsoon surge, (c) Induced ridging in low latitudes, and (d) dynamic ridging. Tropical cyclone track is depicted by circles connected by solid lines. Tropical storm intensities are designated by an open circle, typhoon intensities by filled circle. The 28 Isopleths in panel b means 1028 mb and numbers in panel d (1,2,3 and 4) indicate sequential daily movement.